**Lecture: Sanitation & Creating a Stable Micro-Ecosystem**

**Date: January 28th**

I mentioned last time that brewing beer can be looked at from the perspective of creating a small eco system for tiny organisms in order to give them the best chance to survive and thrive. In order to give yeast the best opportunity to do what you want them to do - make lots of ethanol – you need to learn how to properly prepare their future environment. Like in most lab experiments, preparation is the most time consuming part when brewing.

**Cleaning, Sanitizing and Sterilizing**

**Cleaning** – Mechanical scrubbing of equipment, instruments, and work surfaces. Dirt, organic material, crud from previous brewing, etc. The goal is to remove all stuff which is visible and leave no residue which can harbor micro-organisms for sanitizing and sterilizing.

**Sanitize** – Removal of most micro-organisms >98-99%. Includes bacteria and fungi, 🡪 Other yeasts. The goal is to leave all equipment, instruments, and work surfaces free of contaminants which can interfere with yeast.

**Sterilize** – Removal of all micro-organisms >99%. All life is removed from surfaces. Same goal as with sanitizing.

**Methods**

Cleaning – Physical: Sponges, bottle and carboy brushes, etc.

Sanitizing – Chemical/ Physical

Sterilizing – Physical

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| **Cleaners** | **Amount** | **Info** |
| Detergents | As needed | Unscented, RINSE WELL |
| Sodium Percarbonates:  PBW/Straight A/OxyClean/Baking Soda | PBW: 0.25 Cups per 5 gallons  St A: < 1 TBSP per gallon | Use with Warm Water |
| Chlorine: Bleach | 1-4 TBSP per gallon | Don’t allow to stand in metals |
| Acetic Acid: White Vinegar | Full Strength | Copper Surfaces |
| Vinegar + Hydrogen Peroxide | 2:1 Ratio | Cleaning and removing lead from brass |
| Oxalic Acid-Based  Bar Keepers Friend/ Revere Ware Copper and Stainless Cleanser/ Kleen King Stainless Steel Cleanser | Per Directions | Stainless Steel |

Detergents form films on surfaces that are difficult to remove. Leftover detergent destroys head retention of beer and perfumes can permeate into equipment producing off flavors in your beer. If you do use detergent, rinse thoroughly with hot water.

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| **Sanitizers** | **Amount** | **Info** |
| Chlorine: Bleach | 1 TBSP per gallon | Let sit for 20 minutes, rinse |
| Iodophor | 1 TBSP per 5 gallons | 12.5-25 ppm effectiveness, stains plastic, drain but not required to rinse |
| Phosphoric/Anionic Surfactants:  StarSan/Final Step | 2 TBSP per 5 gallons | Works in 30 seconds, immersion or foam are equally effective, does not produce off flavors, no rinse necessary – wort neutralizes |
| Dry Heat  Oven | 340 F for 60 min  320 F for 120 min  302 F for 150 min  284 F for 180 min  250 F for 12 hours | Make sure glass is clean before, allow to heat/cool slowly to prevent breakage  --Bottles/Glass Fermenters |
| Wet Heat  Pressure Cooker/ Dishwasher/ Autoclave | 257 F for 25 min @ 20 PSI | Sterilize, except Dishwasher > Sanitize  --Bottles/Glass Fermenters |

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| **Sterilize** | **Amount** | **Info** |
| Dry Heat  Oven | 340 F for 60 min  320 F for 120 min  302 F for 150 min  284 F for 180 min  250 F for 12 hours | Make sure glass is clean before, allow to heat/cool slowly to prevent breakage  --Bottles/Glass Fermenters |
| Wet Heat  Pressure Cooker/ Autoclave | 257 F for 25 min @ 20 PSI | Sterilize  --Bottles/Glass Fermenters |

**Water Sanitation for rinsing**

-Use boiled and cooled water for rinsing (safest), don’t recontamination your equipment by using tap water

-Filtered water is adequate for home brewing

**Properties of Metals and Effects on Yeast and Beer**

Many pieces of brewing equipment are made of metal. Metals form a passive surface oxide layer that allows them to be used safely. Removing this layer allows metal ions to dissolve into the wort and can cause a variety of effects.

**Aluminum –** Excellent corrosion resistance, pH 4-8.5, and little to no impact on beer flavor. Forms a surface oxide that is dull in color and provides a barrier between aluminum and wort. A shiny surface means the aluminum is exposed and will dissolve into wort to give a metallic taste. No real effect to yeast.

**Copper** – Excellent heat conduction, dull oxide color, minimal maintenance required. Verdigris, a green/blue colored oxide can form when exposed to highly acidic substances, chlorine, and salts. Cupric acetate, copper sulfate, cupric chloride – these will dissolve into the wort and at high enough levels will poison yeast.

**Brass –** Copper, Zinc, Lead and other small amounts of metals. Lead doesn’t alloy it exists as tiny beads that end up forming a thin layer over brass surfaces. This lead will dissolve into wort unless it is removed. To remove create a 2:1 white vinegar to 3% (by volume) hydrogen peroxide solution and soak brass parts. Parts will turn yellow-gold and shiny. Once lead is removed it will form a passive oxide layer.

**Carbon Steel (Iron) –** Old brewing pots and grain rollers. Rust that forms will produce harsh metal tastes but is relatively harmless to yeast. To inhibit rust apply vegetable oil to the surfaces to prevent contact with moisture.

**Stainless Steel –** Stands up well to all brewing environments. Physical damage, welding/brazing, and chlorine can all damage stainless steel and break the protective passive oxide layer. Using the oxalic acid cleaners restores this protective layer. The risk is economical, stainless steel products are expensive.